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EXAMINER	
GOLDEN, JAMES R	
ART UNIT	**PAPER NUMBER**
2187	

DATE MAILED: 06/07/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/679,559	GARTHWAITE, ALEXANDER T.	
	Examiner	Art Unit	
	James Golden	2187	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 October 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-28* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-28* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *06 October 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *3/5/04, 12/20/05*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

The instant application 10/679559 has a total of 28 claims pending. There are 4 independent claims and 24 dependent claims. Claims 15-21 have been rejected under statutory basis; claims 1-28 have been rejected in view of prior art.

Information Disclosure Statement

1. The information disclosure statements submitted on 03/05/2004 and 12/20/2005 are in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statements are being considered by the examiner.

Specification

2. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed. The title --Concurrent Incremental Garbage Collector With a Card Table Summarizing Modified Reference Locations-- is suggested.

3. The abstract is objected to because of the following informalities: "CAS" (line 4) should be expanded to --compare-and-swap (CAS)--. Appropriate correction is required.

The disclosure is objected to because of the following informalities: the handwritten corrections on pages 35-37 must be corrected.

Claim Objections

4. **Claims 6 and 10-11** are objected to because of the following informalities: "each indicators" (claim 6) should be corrected to --each indicator--; "means for atomic interrogating comprises" (claim 10, line 1) should be corrected to --means for atomically interrogating comprise--; "means for resetting the dirty indicators comprises" (claim 11, lines 1-2) should be corrected to --means for resetting the dirty indicators comprise--.

Claim Rejections - 35 USC § 101

5. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

6. **Claims 15-21** are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. Claims that recite nothing but the physical characteristics of a form of energy, such as a frequency, voltage, or the strength of a magnetic field, define energy or magnetism, per se, and as such are nonstatutory natural phenomena. *O'Reilly*, 56 U.S. (15 How.) at 112-14.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –

> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

8. **Claims 1-4, 6, 8-11, 13, 15-18, 20, 22-25 and 27** are rejected under 35 U.S.C. 102(e) as being anticipated by Kolodner et al. (US 6,490,599).

9. **With respect to claim 1**, Kolodner et al. disclose a method for tracking and summarizing modified references in a garbage collector operating concurrently with applications **(column 5, lines 44-46; column 8, lines 40-44)**, wherein a generation is partitioned into a group of memory sections **(column 7, lines 15-22 describe partitioning the heap into generations; column 4, lines 30-34 describe partitioning the heap into cards that are memory sections)** and wherein there are card table indicators associated with the group of memory sections storing if an application has written into or dirtied one or more of the memory sections **(column 7, lines 55-57; the card table indicator is the "dirty bit for each card", and the card table is composed of the "one dirty bit per object")**, the method comprising the steps of:

- finding and atomically interrogating the indicators and finding at least one dirty indicator **(column 8, line 62 -- column 9, line 2 describes finding the dirty indicator; column 9, lines 8-11 describe an atomic interrogation using a compare-and-swap operation)**,

- resetting the at least one found dirty indicator to indicate not dirty **(column 8, line 62 -- column 9, line 2 describes resetting the dirty indicator)**,
- scanning the at least one dirtied memory section and updating the card table indicators or remembered sets of corresponding objects **(column 8, line 62 -- column 9, line 2 describes updating the color bits, which act as the remembered sets of corresponding objects)**,
- atomically interrogating the indicators again **(column 4, lines 64-67)**, and if none are dirty moving on to collect a next scheduled group of memory sections **(column 4 lines 44-46)**, and if at least one indicator is dirty,
- preserving the indicators as just interrogated **(column 9, lines 56-59)** before moving on to another group of memory sections distant from the next scheduled group **(column 4, lines 64-67)**.

Note: although some of these details are described in the background, they are used in the device of Kolodner et al.; see column 8, lines 22-30.

10. **With respect to claim 2**, Kolodner et al. disclose the method of claim 1 (see above paragraph 9) further comprising the step of preserving information of references to a one younger generation **(column 8, lines 9-14, where the memory objects that may store a reference to a younger generation are colored black for preservation)**.

11. **With respect to claim 3**, Kolodner et al. disclose the method of claim 1 (see above paragraph 9) wherein the step of atomic interrogating comprises executing an instruction selected from the groups consisting of a compare-and-

swap **(column 9, lines 8-11 describe an atomic interrogation using a compare-and-swap operation)**, a load-store-unsigned-byte, and the pair of instructions, load-locked and store-conditional.

12. **With respect to claim 4**, Kolodner et al. disclose the method of claim 1 (see above paragraph 9) wherein the step of resetting of the dirty indicators comprises setting the dirty indicators to empty before scanning **(column 4, lines 49-57, where the scanning is equivalent to tracing)**.

13. **With respect to claim 6**, Kolodner et al. disclose the method of claim 1 (see above paragraph 9) wherein each indicator comprises a byte **(column 8, lines 50-54 where the indicators are byte 40 of Fig. 4A)**.

14. **With respect to claim 8**, Kolodner et al. disclose a computer system for tracking and summarizing modified references in a garbage collector operating concurrently with applications **(column 5, lines 44-46; column 8, lines 40-44)**, wherein a generation is partitioned into a group of memory sections **(column 7, lines 15-22 describe partitioning the heap into generations; column 4, lines 30-34 describe partitioning the heap into cards that are memory sections)** and wherein there are card table indicators associated with the group of memory sections storing if an application has written into or dirtied one or more of the memory sections **(column 7, lines 55-57; the card table indicator is the "dirty bit for each card", and the card table is composed of the "one dirty bit per object")**, the system comprising:

- means for finding and atomically interrogating the indicators and finding at least one dirty indicator **(column 8, line 62 -- column 9, line 2 describes**

finding the dirty indicator; column 9, lines 8-11 describe an atomic interrogation using a compare-and-swap operation),

- means for resetting the at least one found dirty indicator to indicate not dirty **(column 8, line 62 -- column 9, line 2 describes resetting the dirty indicator)**,
- means for scanning the at least one dirtied memory section and updating the card table indicators or remembered sets of corresponding objects **column 8, line 62 -- column 9, line 2 describes updating the color bits, which act as the remembered sets of corresponding objects)**,
- means for atomically interrogating the indicators again **(column 4, lines 64-67)**, and if none are dirty moving on to collect a next scheduled group of memory sections, and if at least one indicator is dirty **(column 4 lines 44-46)**, and
- means for preserving the indicators as just interrogated **(column 9, lines 56-59)** before moving on to another group of memory sections distant from the next scheduled group **(column 4, lines 64-67)**.

Note: although some of these details are described in the background, they are used in the device of Kolodner et al.; see column 8, lines 22-30.

15. **With respect to claim 9**, Kolodner et al. disclose the system of claim 8 (see above paragraph 14) further comprising means for preserving information of references from at least one younger generation **(column 8, lines 9-14, where the memory objects that may store a reference to a younger generation are colored black for preservation)**.

16. **With respect to claim 10**, Kolodner et al. disclose the system of claim 8 (see above paragraph 14) wherein the means for atomic interrogating comprises an instruction selected from the groups consisting of a compare-and-swap **(column 9, lines 8-11 describe an atomic interrogation using a compare-and-swap operation)**, a load-store-unsigned-byte, and the pair of instructions, load-locked and store-conditional.

17. **With respect to claim 11**, Kolodner et al. disclose the system of claim 8 (see above paragraph 14) wherein the means for resetting the dirty indicators comprises means for setting the dirty indicators to empty before scanning **(column 4, lines 49-57, where the scanning is equivalent to tracing)**.

18. **With respect to claim 13**, Kolodner et al. disclose the system of claim 8 (see above paragraph 14) wherein each indicator comprises a byte **(column 8, lines 50-54 where the indicators are byte 40 of Fig. 4A)**.

19. **With respect to claim 15**, Kolodner et al. disclose electromagnetic signals propagating on a computer network comprising the electromagnetic signals carrying instructions for execution on at least one processor **(column 14, lines 10-11)** for the practice of a method for tracking and summarizing modified references in a garbage collector operating concurrently with applications **(column 5, lines 44-46; column 8, lines 40-44)**, wherein a generation is partitioned into a group of memory sections **(column 7, lines 15-22 describe partitioning the heap into generations; column 4, lines 30-34 describe partitioning the heap into cards that are memory sections)** and wherein there are card table indicators associated with the group of memory sections storing if

an application has written into or dirtied one or more of the memory sections **(column 7, lines 55-57; the card table indicator is the "dirty bit for each card", and the card table is composed of the "one dirty bit per object")**, the method comprising the steps of:

- finding and atomically interrogating the indicators and finding at least one dirty indicator **(column 8, line 62 -- column 9, line 2 describes finding the dirty indicator; column 9, lines 8-11 describe an atomic interrogation using a compare-and-swap operation)**,
- resetting the at least one found dirty indicator to indicate not dirty **(column 8, line 62 -- column 9, line 2 describes resetting the dirty indicator)**,
- scanning the at least one dirtied memory section and updating the card table indicators or remembered sets of corresponding objects **(column 8, line 62 -- column 9, line 2 describes updating the color bits, which act as the remembered sets of corresponding objects)**,
- atomically interrogating the indicators again **(column 4, lines 64-67)**, and if none are dirty moving on to collect a next scheduled group of memory sections **(column 4 lines 44-46)**, and if at least one indicator is dirty,
- preserving the indicators as just interrogated **(column 9, lines 56-59)** before moving on to another group of memory sections distant from the next scheduled group **(column 4, lines 64-67)**.

Note: electromagnetic signals are inherently taught by Kolodner et al. because the information required to complete the method of claims 1-7 by executing a

program on the processor transfers data electromagnetically from the memory to the processor.

Note: although some of these details are described in the background, they are used in the device of Kolodner et al.; see column 8, lines 22-30.

20. **With respect to claim 16**, Kolodner et al. disclose the electromagnetic signals of claim 15 (see above paragraph 19) further comprising signals for the practice of the step of preserving information of references to a one younger generation **(column 8, lines 9-14, where the memory objects that may store a reference to a younger generation are colored black for preservation)**.

21. **With respect to claim 17**, Kolodner et al. disclose the electromagnetic signals of claim 15 (see above paragraph 19) wherein the step of atomic interrogating comprises executing an instruction selected from the groups consisting of a compare-and-swap **(column 9, lines 8-11 describe an atomic interrogation using a compare-and-swap operation)**, a load-store-unsigned-byte, and the pair of instructions, load-locked and store-conditional.

22. **With respect to claim 18**, Kolodner et al. disclose the electromagnetic signals of claim 15 (see above paragraph 19) wherein the step of resetting of the dirty indicators comprises setting the dirty indicators to empty before scanning **(column 4, lines 49-57, where the scanning is equivalent to tracing)**.

23. **With respect to claim 20**, Kolodner et al. disclose the electromagnetic signals of claim 15 (see above paragraph 19) wherein each indicators comprises a byte **(column 8, lines 50-54 where the indicators are byte 40 of Fig. 4A)**.

24. **With respect to claim 22**, Kolodner et al. disclose a computer readable media comprising: the computer readable media containing instructions for execution in a processor **(column 14, lines 10-11)** for the practice of a method for tracking and summarizing modified references in a garbage collector operating concurrently with applications **(column 5, lines 44-46; column 8, lines 40-44)**, wherein a generation is partitioned into a group of memory sections **(column 7, lines 15-22 describe partitioning the heap into generations; column 4, lines 30-34 describe partitioning the heap into cards that are memory sections)** and wherein there are card table indicators associated with the group of memory sections storing if an application has written into or dirtied one or more of the memory sections **(column 7, lines 55-57; the card table indicator is the "dirty bit for each card", and the card table is composed of the "one dirty bit per object")**, the method comprising the steps of:

- finding and atomically interrogating the indicators and finding at least one dirty indicator **(column 8, line 62 -- column 9, line 2 describes finding the dirty indicator; column 9, lines 8-11 describe an atomic interrogation using a compare-and-swap operation)**,
- resetting the at least one found dirty indicator to indicate not dirty **(column 8, line 62 -- column 9, line 2 describes resetting the dirty indicator)**,
- scanning the at least one dirtied memory section and updating the card table indicators or remembered sets of corresponding objects **(column 8,**

line 62 -- column 9, line 2 describes updating the color bits, which act as the remembered sets of corresponding objects),

- atomically interrogating the indicators again **(column 4, lines 64-67)**, and if none are dirty moving on to collect a next scheduled group of memory sections **(column 4 lines 44-46)**, and if at least one indicator is dirty,
- preserving the indicators as just interrogated **(column 9, lines 56-59)** before moving on to another group of memory sections distant from the next scheduled group **(column 4, lines 64-67)**.

Note: although some of these details are described in the background, they are used in the device of Kolodner et al.; see column 8, lines 22-30.

25. **With respect to claim 23**, Kolodner et al. disclose the computer readable media of claim 22 (see above paragraph 24) further comprising media containing instructions for the practice of the step of preserving information of references to a one younger generation **(column 8, lines 9-14, where the memory objects that may store a reference to a younger generation are colored black for preservation)**.

26. **With respect to claim 24**, Kolodner et al. disclose the computer readable media of claim 22 (see above paragraph 24) wherein the step of atomic interrogating comprises executing an instruction selected from the groups consisting of a compare-and-swap **(column 9, lines 8-11 describe an atomic interrogation using a compare-and-swap operation)**, a load-store-unsigned-byte, and the pair of instructions, load-locked and store-conditional.

27. **With respect to claim 25**, Kolodner et al. disclose the computer readable media of claim 22 (see above paragraph 24) wherein the step of resetting of the dirty indicators comprises setting the dirty indicators to empty before scanning **(column 4, lines 49-57, where the scanning is equivalent to tracing)**.

28. **With respect to claim 27**, Kolodner et al. disclose the computer readable media of claim 22 (see above paragraph 24) wherein each indicators comprises a byte **(column 8, lines 50-54 where the indicators are byte 40 of Fig. 4A)**.

Claim Rejections - 35 USC § 103

29. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

30. **Claims 5, 12, 19 and 26** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kolodner et al. (US 6,490,599).

31. **With respect to claim 5, 12, 19 and 26**, Kolodner et al. disclose the method of claim 1 (see above paragraph 9), the system of claim 8 (see above paragraph 14), the electromagnetic signals of claim 15 (see above paragraph 19) and the computer readable media of claim 22 (see above paragraph 24). Kolodner et al. do not disclose the limitation wherein a dirty indicator contains all zeros and an empty indicator contains all ones.

However, Kolodner et al. disclose the limitation wherein a dirty indicator contains all ones and an empty indicator contains all zeros **(column 8, lines 50-53 describe a dirty indicator containing a one, and an empty indicator containing a zero)**. Although the opposite values are used to signify the dirty and empty indicators, one of ordinary skill in the art would realize that the mere switching of values would not produce unexpected results and but would still produce the desired result. Also, applicant's specification does not recite that the link between the specific values and indicators would result in unexpected results. Thus, this representation of values taught by Kolodner et al. is effectively equivalent to the claimed representation, and therefore reads upon the claimed subject matter.

32. **Claims 7, 14, 21 and 28** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kolodner et al. (US 6,490,599) in view of Kolodner et al. (US 20020055941).

33. **With respect to claim 7, 14, 21 and 28**, Kolodner et al. disclose the method of claim 1 (see above paragraph 9), the system of claim 8 (see above paragraph 14), the electromagnetic signals of claim 15 (see above paragraph 19) and the computer readable media of claim 22 (see above paragraph 24) wherein the memory sections are defined as cards **(column 4, lines 30-35; column 7, lines 50-54)**. Kolodner et al. do not disclose the limitation wherein the indicators comprise a card table of bytes that correspond to the memory cards.

However, Kolodner et al. (US 20020055941) disclose the limitation wherein the indicators comprise a card table of bytes that correspond to the

memory cards **(535 of Fig. 1; paragraph 0128, where a fixed unit of the heap is equivalent to a card)**.

Kolodner et al. (US 6,490,599) and Kolodner et al. (US 20020055941) are analogous art because they are from the same field of endeavor, namely memory garbage collection.

At the time of invention, it would have been obvious to a person of ordinary skill in the art to combine the card table of bytes of Kolodner et al. (US 6,490,599) with the garbage collector of Kolodner et al. (US 20020055941). The motivation for doing so would have been because the card table "can be manipulated more quickly" than a card table composed of bits **(paragraph 0128, lines 14-16)**.

Therefore, it would have been obvious to a person of ordinary skill in the art to combine the card table of Kolodner et al. (US 20020055941) with Kolodner et al. (US 20020055941) for the benefit of a garbage collector with a card table composed of bytes to obtain the invention as specified in claims 7, 14, 21 and 28.

Conclusion

34. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

- Borman et al. (US 6,845,437) teach a card table;
- Flood et al. (US 6,560,619) teach a garbage collector with a card table;
- Garthwaite (US 6,424,977) teaches a garbage collector with a card table;
- Detlefs (US 2004/0162860) teaches a garbage collector with a card table;

- Nagarajan et al. (US 2004/0003014) a teach garbage collector with a card table; and
- Jeffrey et al. (US 2002/0065986) teach a system for copying and storing dirty bits in a memory.

35. Any inquiry concerning this communication or earlier communications from the examiner should be directed to James Golden whose telephone number is 571-272-5628. The examiner can normally be reached on Monday-Friday, 8:30 AM - 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Donald Sparks can be reached on 571-272-4201. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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5/26/06